REMARKS

Claims 1, 2, 4-6, 8 and 31- 46, are all the claims presently being examined in this application. Claims 1, 2, 4-6, 8 and 31-46 stand rejected on prior art grounds.

Claims 1, 2, 4-6, 8, 31, 34, 37, 41, and 42-44 stand rejected under 35 U.S.C. § 102(e) as being unpatentable over Lou, et al. (U.S. Patent No. 6,277,732 B1). Claims 32, 36 and 38 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lou as applied to claims 1, 2, 4-6, 8, 31, 34, 37, 41, and 42-44 above, and in further view of the Applicant's Admitted Prior Art. Claim 33 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Lou as applied to claims 1, 2, 4-6, 8, 31, 34, 37, 41, and 42-44 above, and in further view of Aoi (U.S. Patent No. 6,333,257 B1). Claim 35 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Lou as applied to claims 1, 2, 4-6, 8, 31, 34, 37, 41, and 42-44 above, and in further view of Yau, et al. (U.S. Patent No. 6,072,227). Claims 39, 40, 45, and 46 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lou as applied to claims 1, 2, 4-6, 8, 31, 34, 37, 41, and 42-44 above, and in further view of Allada, et al. (U.S. Patent No. 6,218,317 B1) and Wolf, et al. (Silicon Processing For The VLSI Era, Volume 1), alone or in combination with Chen, et al. (Effects of Slurry Formulations on Chemical-Mechanical Polishing of Low Dielectric Constant Polysiloxanes: Hydro-Organo Siloxane and Methyl Silsesquioxane, J.Vac. Sci. Technol. B 18(1) Jan/Feb 2000). Claim 43 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Lou as applied to claims 1, 2, 4-6, 8, 31, 34, 37, 41, and 42-44 above, and in further view of Lu, et al. (U.S. Patent No. 6,008,540). Reconsideration is respectfully requested.

These rejections are respectfully traversed in view of the following discussion.

Entry of this § 1.116 Amendment is proper. Since the amendments above narrow the issues for appeal and since such features were in the claims earlier, such amendments do not raise a new issue requiring further searching and/or consideration by the Examiner. As such, entry of this Amendment is believed to be proper and is earnestly solicited.

It is noted that the amendments are made only to overcome the Examiner's non-statutory objections, and to more particularly define the invention and not for distinguishing the invention over the prior art, for narrowing the scope of the claims, or for any reason related to a statutory requirement for patentability.

It is further noted that, notwithstanding any claim amendments made herein, Applicant's intent is to encompass equivalents of all claim elements, even if amended herein or later during prosecution.

I. THE CLAIMED INVENTION

An aspect of the invention includes a second insulation layer which includes a hydride organosiloxane, and the second insulation layer includes a layer to improve an adhesion property between the first insulation layer and the third insulation layer. Thus, the second insulation layer provides good interlayer adhesion between the first insulation layer and the third insulation layer, and thus effectively prevents peeling of the three insulation layers from each other. (See Page 8, lines 7-9; Page 13, lines 1-7; Page 16, lines 8-25; Page 21, line 12-Page 22, line 14; Page 23, lines 10-15; Page 25, line 21-Page 26, line 9; and Figures 1-4).

II. THE PRIOR ART REJECTIONS

A. The 35 USC § 102(e) Rejection Based on Lou, et al.

Lou, U.S. Patent Number 6,277,732, ("Lou") fails to disclose, teach or suggest the features of independent claims 1, 5, 41 and 42, including the second insulation layer includes a hydride organopolysiloxane, and the second insulation layer includes a layer to improve an adhesion property between the first insulation layer and the third insulation layer. (See Page 16, lines 8-25; Page 21, line 12-Page 22, line 10; Page 25, lines 4-26; and Figures 1-3 and 10(a)-(c)).

As noted above, in Applicant's invention (e.g., as defined in Claim 1), the semiconductor device includes a multi-layered insulation film including a first insulation film layer 2, a second insulation layer 3, and a third insulation layer 4. The second insulation layer 3 is formed on and adheres to a top of the first insulation layer 2, and the third insulation layer 4 is formed on and adheres to a top of the second insulation layer 2. The second insulation layer is formed from a polysiloxane compound, which includes a hydride organopolysiloxane, e.g., methylated hydrogen silsesquioxane, for example, as recited in claims 39 and 46. Thus, the second insulation film helps to bind the first and third insulation layers, which provides good interlayer adhesion between the first insulation layer and the third insulation layer, thereby improving an adhesion property between the first and third insulation layers.

In contrast, Figures 1A-1E of Lou merely teaches a method of planarizing an inter-metal dielectric layer, and a related structure. The method includes using a spin-on glass process to form an organic dielectric layer 208 over a dielectric liner layer 206, forming an inorganic dielectric layer 210 (what the Examiner attempts to analogize to a second insulation layer) over

the organic dielectric layer 208, and forming a cap dielectric layer 212 over the inorganic dielectric layer 210 .

Contrary to the assertion in the Office Action, the inorganic dielectric layer 210 "is preferably formed using material such as hydrogen silsesquioxane (HSQ), methyl silsesquioxane (MSQ) or fluorosilicate glass (FSG)," which are not structurally equivalent to an organic compound, such as, hydride organopolysiloxane compound, and, for example, methylated hydrogen silsesquioxane (MHSQ).

Accordingly, Lou does not teach or suggest forming the inorganic dielectric layer 210 from a hydride organopolysiloxane compound. Importantly, the dielectric (insulation) layer 210 is the layer in order not to decrease a thermal conductivity. That is, dielectric layer 210 is for maintaining a thermal conductivity, not for promoting an adhesion property between layer 208 and 212 of Lou, et al. Therefore, the adhesion may likely not be strong among the organic dielectric layer 208, the inorganic dielectric layer 210 and the cap dielectric layer 212, and thus peeling may occur with this configuration. Thus, the highly adhesive feature is not inherent as asserted in the Office Action. (See Office Action, Page 2-Page 3, Section 3; Page 7, lines 1-6; and Lou, Column 3, line 64-Column 4, line 6).

Lou, therefore, does not, teach, suggest or disclose including the second insulation layer includes a hydride organopolysiloxane, and that the second insulation layer comprises a layer to improve an adhesion property between the first insulation layer and the third insulation layer, as recited in independent claims 1, 5, 41 and 42.

For at least the reasons outlined above, Applicant respectfully submits that Lou does not

disclose, teach or suggest all the features of independent claims 1, 5, 41 and 42, and related dependent claims 2, 4, 6, 8, 31, 34, 37, and 44, which are patentable not only by virtue of their dependency from their respective independent claim but also by the additional limitations they recite. Accordingly, Lou does not anticipate or render obvious the subject matter of independent claims 1, 5, 41 and 42.

For the reasons stated above, the claimed invention is fully patentable over the cited reference.

B. The 35 USC § 103(a) Rejection Based on Lou, et al. as applied to claims 1, 2, 4-6, 8, 31, 34, 37, 41, 42 and 44, and further in view of the Admitted Prior Art

Regarding claims 32, 36 and 38, to make up for the deficiencies of Lou, the Examiner relies on the Applicant's Admitted Prior Art ("APA"). The APA fails to do so.

First, the APA, pertains to a process of forming a damascene copper wiring system of a low dielectric constant material. APA is specifically directed to decreasing inter-wire capacity in order to cope with the higher-speed operation of semiconductor devices. (See Application, Background Section, Page 1, 2nd and 3rd Paragraphs, lines 8-15).

Nothing within APA, which focuses on decreasing the inter-wire capacity in order to cope with the higher-speed operation of semiconductor devices, has anything to do with minimizing the "severity of the thermal conductivity problem resulting from the use of organic material" as disclosed in Lou. Thus, Lou teaches away from being combined with another invention such as, for example, APA.

Therefore, the urged combination would not have been made, absent hindsight.

Secondly, like Lou, the APA does not disclose, teach or suggest, including that a second insulation layer includes a hydride organosiloxane, and that the second insulation layer comprises a layer to improve an adhesion property between the first insulation layer and the third insulation layer as recited in independent claim 1.

Further, APA does not disclose, teach or suggest, including the first insulation layer includes at least one of an organosiloxane and an aromatic-containing organic resin as recited in claim 2. APA also does not disclose, teach or suggest, including the organopolysiloxane includes at least one of an alkyl silsesquioxane and a hydride alkyl siloxane as recited in claim 32. APA further does not disclose, teach or suggest, including the first insulation layer includes methyl silsesquioxane as recited in amended claim 36. In addition, APA does not disclose, teach or suggest, including the plurality of wires includes copper wires as recited in claim 38.

Instead, Figures 6(a)-(c) of the APA merely disclose a curing system in which wires are formed in an insulation film having only two layers, and the APA's deficiencies have been discussed in the previous Amendment.

Thus, APA would not have been combined with Lou, and does not teach or suggest, including a second insulation layer comprised of a polysiloxane compound, let alone that the second insulation layer includes a hydride organosiloxane, and that the second insulation layer comprises a layer to improve an adhesion property between the first insulation layer and the third insulation layer.

For the reasons stated above, the claimed invention, and the invention as cited in independent claim 1, and related dependent claims 2, 32, 36 and 38, should be fully patentable

over the cited references.

C. The § 103(a) Rejection of Claim 33 Based on Lou, and further in view of Aoi

Regarding claim 33, to make up for the deficiencies of Lou, the Examiner relies on Aoi. The Aoi reference fails to do so.

Aoi focuses on an interlevel insulating film with a low dielectric constant, with improved adherence to an organic film, an oxide film or a metal film, has anything to do with minimizing the "severity of the thermal conductivity problem resulting from the use of organic material" as disclosed in Lou.

Therefore, give the vastly different problems and approaches, the urged combination would not have been made, absent hindsight.

Secondly, like Lou, Aoi does not disclose, teach or suggest, a second insulation layer which includes a hydride organosiloxane, and that the second insulation layer comprises a layer to improve an adhesion property between the first insulation layer and the third insulation layer as recited in independent claim 1.

Further, Aoi does not disclose, teach or suggest, including the first insulation layer includes at least one of an organosiloxane and an aromatic-containing organic resin as recited in claim 2. Aoi also does not disclose, teach or suggest, including the aromatic-containing organic resin includes at least one of a polyaryl ether and a divinyl siloxane-bis-benzocyclobutene as recited in claim 33 of the invention.

For the reasons stated above, and in the previous Amendment, incorporated herein by reference, the claimed invention, and the invention as cited in independent claim 1, and related dependent claims 2 and 33, is fully patentable over the cited references.

D. The 35 USC § 103(a) Rejection Based on Lou in view of Yau, et al.

Regarding claim 35, to make up for the deficiencies of Lou, the Examiner relies on Yau, et al. ("Yau"). Yau fails to do so.

First, Yau would not have been combined with Lou for all of the reasons in the previous Amendment, incorporated herein by reference.

Therefore, the urged combination would not have been made, absent hindsight.

Secondly, like Lou, Yau does not disclose, teach or suggest, including a second insulation layer which includes a hydride organosiloxane, and that the second insulation layer comprises a layer to improve an adhesion property between the first insulation layer and the third insulation layer as recited in independent claim 1.

Further, Yau does not disclose, teach or suggest, including the second insulation layer includes a first layer and a second layer placed in the first layer as recited in claim 35 of the invention, as discussed previously.

Instead, Figures 8H and 10H of Yau merely disclose a dual damascene structure including a first intermetal dielectric layer 510, 710 deposited on a substrate 512, 712, a low K adhesive layer 514, 714 deposited on the first intermetal dielectric layer 510, 710, a "conventional silicon oxide or silicon nitride etch stop" 716 deposited on the adhesive layer 714, a second low K

adhesive layer 718 deposited on the etch stop 716 or, similarly, a second dielectric layer 518 deposited on the low k etch stop 514 and contact/via openings. Further, a second intermetal dielectric layer 722 is deposited on the second low K adhesive layer 718. The low K adhesive layer, 514, 714, 518, 718, is formed from an oxidized organo silane where the preferable organo silane compounds include methyl silane, dimethyl silane, or trimethyl silane. These organo silane compounds are not structurally equivalent to a hydride organosiloxane compound, and more particularly, for example, methylated hydrogen silsesquioxane (MHSQ). (See Yau, Column 5, lines 11-45; Column 13, lines 9-36; Column 14, lines 10-45; and Figures 8A-H and 10A-H).

Indeed, the Office Action does not provide or identify any specific citation in Yau, which discloses or expressly or impliedly suggests that the the low K adhesive layer, 514, 516, 714, 518, 718, can be formed from a hydride organosiloxane, e.g., a methylated hydrogen silsesquioxane (MHSQ). Yau only discloses, and teaches that the etch stop 716 s a "conventional silicon oxide or silicon nitride etch stop," and does not disclose, teach or suggest, that the etch stop 716 is an oxidized organic silane layer as suggested.

For emphasis, the Application specifically explains the problems with such a design, for example, as taught by Yau, including the low resistance to chemical solutions and difficulty in forming the contact hole of the designated shape, and how the present invention having a multi-layered film (e.g., including at least three layers) overcomes these problems.

Thus, Yau would not have been combined with Lou, and does not disclose, teach or suggest a second insulation layer, which includes a hydride organosiloxane, and that the second

insulation layer comprise a layer to improve an adhesion property between the first insulation layer and the third insulation layer.

For the reasons stated above, the claimed invention, and the invention as cited in independent claim 1, and related dependent claim 35, are fully patentable over the cited references.

E. The 35 USC § 103(a) Rejection of Claims 39, 40, 45 and 46 Based on Lou, in view of Allada, et al. and Wolf, et al., alone, or in combination, with Chen, et at al.

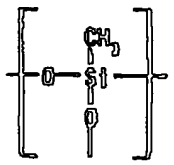
The references separately, or in combination, fail to disclose, teach or suggest a reason or motivation for being combined, for all of the reasons in the June 3, 2004, Amendment, incorporated herein by reference.

Brieflyy, none of the above references ocus on bonding of various layers in a semiconductor device as disclosed in Applicant's invention. Therefore, the urged combination would not have been made, absent hindsight.

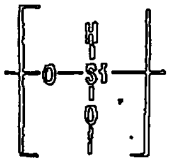
Secondly, like Lou, Allada, Wolf and Chen do not disclose, teach or suggest, including that a second insulation layer includes a hydride organosiloxane, and that the second insulation layer comprises a layer to improve an adhesion property between the first insulation layer and the third insulation layer as recited in independent claim 1 and 42.

Further, Allada does not disclose, teach or suggest, including the second insulation layer includes a methylated hydrogen silsesquioxane (MHSQ) film as recited in claim 39. Allada also does not disclose, teach or suggest, including the MHSQ film has a thickness of about 50 nm as

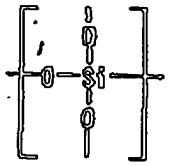
recited in claim 40 of the invention. Allada further does not disclose, teach or suggest, including the second insulation layer is formed by one of a plasma CVD and a spin coating process where the semiconductor substrate is continuously maintained in a plasma atmosphere as recited in claim 45. Allada also does not disclose, teach or suggest, including the hydride organosiloxane comprises methylated hydrogen silsesquioxane including repeating units shown by formulae I, II and III.



(I)



(II)



(III) , and

a molar ratio of II to a total of I, II and III is at least 0.2 as recited in claim 46.

Again, Figures 1a-1b of Allada teach multilevel interconnects for integrated circuit devices, in particular, copper/dual damascene devices, and related fabrication methods. "Methylated-oxide type hardmasks 18 are formed over polymeric interlayer dielectric materials 16" where the hardmask and the interlayer dielectric may be spincoated. The "[d]ielectric layer 16 is etched and then electroplated with copper to produce the single damascene structure 10 with a copper line 20." Accordingly, a single metal copper line 20 is embedded in a recess formed between the methylated-oxide hardmask 18 and the interlayer dielectric material 16.

Further, Figures 2a and 2b of Allada teach a dual damascene structure 22 that "can be formed by spinning four alternating layers of polymeric interlayer dielectric 24, 26 and hardmask 28, 30 followed by etch and copper electroplating to form copper line 32." Importantly, as

discussed above, the insulation layer 210 of Lou is the layer in order not to decrease a thermal conductivity (e.g., layer 210 is for maintaining thermal conductivity). In contrast, the insulation layer of Allada is a layer which functions as a hardmask. In contrast, the claimed second insulation is for improving an adhesion property between the first and third insulation layers. Further, in the Allada structure, the hardmask 28, 30 formed from Allied Signal's HOSP™, is situated between two polymer layers, whereas Applicant teaches that the second insulation layer is situated between a first insulation layer having a dielectric constant lower than silicon dioxide and a third insulation layer comprised of an inorganic material. Accordingly, neither Figures 1 and 2 of Allada teach or suggest Applicant's structural configuration.

Although methylated hardmasks 18, 28 and 30 include an organic low-k hydrido organic siloxane polymer, i.e., Allied Signal's HOSP™ proprietary material, Applicant respectfully submits that the Examiner mischaracterizes the HOSP™ proprietary material as being structurally and functionally equivalent to the methylated hydrogen silsesquioxane (MHSQ) film. Instead, contrary to the assertion in the Office Action, Allada's methylated hardmask 18, is more structurally and functionally equivalent to a hardmask layer with insulative properties, primarily used in spin-coating techniques. Allada does not teach or suggest that the HOSP™ is used as an adhesive. Indeed, "significant advantage can be achieved by forming a methylated oxide-type dielectric such as Allied Signal's HOSP™ material by spin coating techniques." (See Allada, Column 2, line 8-Column 3, line 35).

For emphasis, as discussed above, the insulation layer 210 of Lou is the layer in order not to decrease a thermal conductivity, and the insulation layer of Allada is the layer which functions as a hardmask.

Wolf and Chen do not resolve the deficiencies of Allada, as discussed previously in the June 3, 2004, Amendment.

F. The § 103(a) Rejection Based on Lou as applied to claims 1, 2, 4-6, 8, 31, 34, 37, 41, 42 and 44, and further in view of Lu

Regarding claim 43, to make up for the deficiencies of Lou, the Examiner relies on Lu. The Lu reference fails to do so.

Nothing within Lu, as previously discussed, which focuses on a surface treatment for porous silica to enhance adhesion of the subsequent overlying layers, has anything to do with minimizing the "severity of the thermal conductivity problem resulting from the use of organic material" as disclosed in Lou. Thus, Lou teaches away from being combined with another invention such as Lu. (See Lu at Abstract; Column 1, lines 14-25; and Column 1, line 60-Column 2, line 7).

Therefore, the urged combination would not have been made, absent hindsight.

Secondly, like Lou, Lu does not disclose, teach or suggest, a second insulation layer which includes a hydride organosiloxane, and that the second insulation layer comprises a layer to improve an adhesion property between the first insulation layer and the third insulation layer as recited in independent claim 1.

Further, Lu does not disclose, teach or suggest, including the first insulation layer, the second insulation layer and the third insulation layer of the multi-layered insulation film comprise substantially uniform widths as recited in claim 43 of the invention.

Accordingly, Applicant agrees with the Examiners' previous assertion that Lu does not disclose, teach or suggest, a second insulation layer which includes a hydride organosiloxane, let alone that the second insulation layer comprises a layer to improve an adhesion property between the first insulation layer and the third insulation layer as claimed by Applicant. (See Office Action, Page 9, 1st Paragraph; Office Action, February 24, 2004, Page 3, lines 6-7, and Page 6, Section 8; Lu at Abstract; Column 1, lines 33-61; Column 3, line 48-Column 6, line 62; and Figures 2b and 3f).

Thus, Lu would not have been combined with Lou, and does not teach or suggest including a second insulation layer which includes a hydride organosiloxane, and that the second insulation layer comprises a layer to improve an adhesion property between the first insulation layer and the third insulation layer.

For the reasons stated above, the claimed invention, and the invention as cited in independent claim 1, and related dependent claim 43, should be fully patentable over the cited references.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1, 2, 4-6, 8 and 31-46, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the

Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully submitted,

Date: 9/15/04

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CERTIFICATION OF FACSIMILE TRANSMISSION

I hereby certify that the foregoing Amendment was filed via facsimile this 15th day of September, 2004, with the United States Patent and Trademark Office, Examiner Julio J. Maldonado, Group Art Unit # 2823, at fax number (703) 872-9306.

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